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INSTRUCTION MANUAL
FOR
MODEL TTS 36
SWITCH PULSING TEST SET

TTS-36

NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 – CONCORD, N.H. 03301

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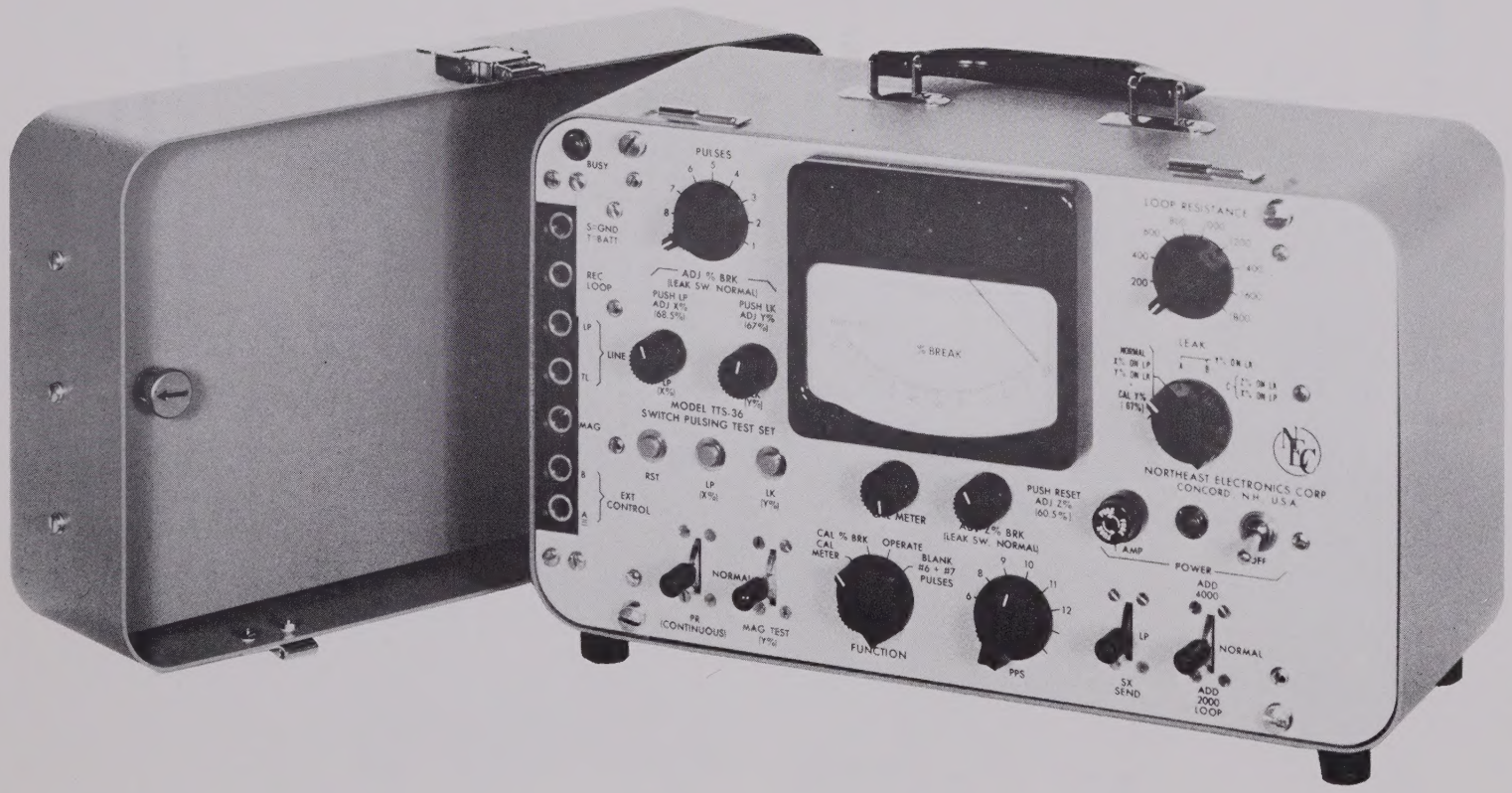
TABLE OF CONTENTS

Section		Title	Page
1		DESCRIPTION AND SPECIFICATIONS	1-1
	1.1	General	1-1
	1.12	Specifications	1-2
	1.23	Accessories	1-3
2		OPERATING INSTRUCTIONS	2-1
	2.1	General	2-1
	2.2	Calibration	2-3
	2.4	Operating Instructions	2-4
3		CIRCUIT DESCRIPTION	3-1
	3.1	General	3-1
	3.2	Pulse Generating Section	3-1
	3.7	Pulse Gating Section	3-2
	3.12	Loop, Leak and Busy Sensing Section	3-3
	3.23	Oscillator-Buffer Amplifier Circuit	3-6
4		MAINTENANCE INSTRUCTIONS	4-1
	4.1	Oscillator-Buffer Amplifier Maintenance and Fault Finding	4-1
5		ELECTRONIC PARTS LIST	5-1
		TTS 36 Main Assembly	5-3
		Pulse Generator (PC Bd. E95026)	5-7
		PC Bd. E95051	5-9
		List of Manufacturers	5-10

LIST OF ILLUSTRATIONS

Figure	Title	Page
2-1	Front Panel Controls	Facing 2-1
3-1	TTS 36 Switch Pulsing Test Set	End of Section 3
3-2	Oscillator-Buffer Amplifier	End of Section 3
5-1	TTS 36 Top and Rear View	5-2
5-2	PC Bd. E95026	5-6
5-3	PC Bd. E95051	5-8


BUSY
PULSES
SIGND
TBATT
REC
LOOP
LP
TL
LINE
MAG
EXT
CONTROL
ADJ % BRK
(LEAK SW. NORMAL)
PUSH LP
ADJ X%
(68.5%)
PUSH LK
ADJ Y%
(67%)
% BREAK
MODEL TTS-36
SWITCH PULSING TEST SET
RST
LP
(X%)
LK
(Y%)
METER
PUSH RESET
ADJ Z%
(60.5%)
% BRK
(LEAK SW. NORMAL)
LOOP RESISTANCE
LEAK
NORMAL
X% ON LP
Y% ON LK
CAL Y%
(67%)
NORTHEAST ELECTRONICS CORP
CONCORD, N.H. U.S.A.
AMP
POWER
OFF
CAL % BRK
CAL
METER
OPERATE
BLANK
#6 & #7
PULSES
NORMAL
PR
(CONTINUOUS)
MAG. TEST
(Y%)
FUNCTION
PPS
SX
SEND
ADD
4000
NORMAL
ADD
2000
LOOP

SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL

1.2 The Model TTS 36 Switch Pulsing Test Set provides groups of signaling pulses or a continuous pulse train, through various leak, loop, and test circuitry. Such preset groups of pulses are useful for testing step by step switches and pulse correcting repeaters. A magnet pulsing test allows a switch mechanism to be operated independently of its associated pulsing relay.

1.3 Combinations of pulsing speed and % break, in conjunction with leak and loop tests, simulate the range of service conditions imposed on the pulsing mechanism of the switches.

1.4 Jack designations are consistent with the markings on various types of instruments that have been used in the industry.

1.5 A switch designated PULSES is provided to establish the number of pulses sent out in a group. Any number of pulses between 1 and 9 may be selected. It is thus possible to position a selector or connector to a desired level. Accurate adjustment of the % break of the pulses is accomplished by ADJUST % BRK controls and a $4\frac{1}{2}$" meter with .1% divisions located on the front panel.

1.6 A key switch which has positions marked NORMAL and PR is used to select continuous pulses (PR) or a group of pulses (NORMAL). A magnet pulsing test, which permits a check of the switch mechanism, independent of the pulsing relay, may be made by placing the NORMAL/MAG TEST key in the MAG TEST position and connecting the MAG jack to the back contact spring of the A relay of the switch under test. The test is applied by momentarily depressing the LK pushbutton of the TTS 26XPC Control Unit.

1.7 In addition to the variable % break and variable speed pulsing checks, an interdigital timing test of the C relay of step by step switches is provided. This test is accomplished by selecting a group of 9 pulses and setting the FUNCTION switch to the full clockwise position to blank out pulses 6 and 7. Correct operation of the C relay is indicated when the selector cuts in on the 5th level. Cutting in on a different level indicates improper adjustment of the C relay.

1.8 Two switches are provided to introduce a balanced loop resistance in 200 ohm increments, up to a total of 5800 ohms, between the pulsing circuit of the TTS 36 and the circuit under test. The first, a 10-position rotary switch designated LOOP RESISTANCE, provides balanced loop resistances in 200 ohm increments from 0 to 1800 ohms. The second, a key switch designated ADD, can switch 2000 or 4000 ohm increments in series with the values established by the LOOP RESISTANCE switch.

1.9 A LEAK switch is also provided to apply standard LEAK A, B, OR C line conditions to the circuit under test.

1.10 A 2 conductor cord (tip and sleeve) with a 310 type or equivalent plug on the end of the cord toward the set is required to provide 48 volt DC office battery to the set. A 3 conductor cord with a 310 type or equivalent plug on the end of the cord toward the set is required for use with the LP or TL jack of the set for tests which use these jacks. A 2 conductor cord (tip and ring) with 310 type or equivalent plug on the end of the cord towards the set is required for the magnet test of the step by step switch. Because of the current carrying limitation, a 2 conductor cord with tinsel conductors (frequently used for 2 conductor cords) is not satisfactory for connection between the MAG TEST jack and the magnet of the step by step switch.

1.11 The set operates from 48 volt DC central office battery and is contained in a 14" x 10" x 8" aluminum carrying case with a removable hinged cover which includes a storage compartment for the TTS 26XPC, cords, small tools, and other items.

1.12 SPECIFICATIONS

1.13 The Model TTS 36 Switching Pulse Test Set is designed to provide a specific number of pulses within a pulse train to a circuit under test. The operating parameters of this unit are as follows:

1.14 Pulse Generator

Maximum % break 80%
Minimum % break 40%
Speed of Pulses: switchable 6, 8, 9, 10, 11, and 12 pps
Selection of a group of 1 through 9 or continous pulses

1.15 Line Conditions

Loop Resistance: Switchable in 200 ohm increment from 0 to 5800 ohms.

Leak Resistance: Switchable
Leak A - 10,250 ohms in parallel with a series combination of 5050 ohms and 2.16μF.
Leak B - 10,250 ohms
Leak C - 10,250 ohms in parallel with a series combination of 600 ohms and 2.16μF.

1.16 Calibration. An adjustable calibration control on the front panel permits normal operation of the set on battery voltages ranging from approximately 45 to 55 volts.

1.17 Power Requirements

48 volts DC, 200 mA
Operational from approximately 45 to 55 volts
Diode protection for polarity reversal

1.18 Size: 14"w x 10"h x 8"d

1.19 Weight: 15½ lb.

1.20 Bias Switching (% Break). Bias switching is accomplished internally to provide the proper % break (after initial adjustment) to correspond to the individual leak, loop, or magnet test functions as required.

1.21 Send Relay Contacts. The send relay (located within the TTS 36) is a high speed telegraph type relay. Representative units have driven a selector to the 9th level in excess of one hundred thousand times with no serious build-up or deterioration of the send relay contacts.

1.22 Temperature. This unit is designed to operate satisfactorily over temperatures ranging from 30°F to 130°F.

1.23 Accessories

1.24 An accessory unit, the TTS 26XPC Control Unit or the equivalent Western Electric 36B Test Set, may be connected to jacks in the test set to provide remote control. These control units have push buttons for controlling the pulses sent through the established leak or loop circuit to operate the step by step switches and pulse repeater circuits, and a pushbutton for restoring the circuit to normal. The control unit plugs into the A and B jacks of the front panel.

1.25 An optional power supply designated as TTS 36XPS is available (117 V ac to 48 V dc.)

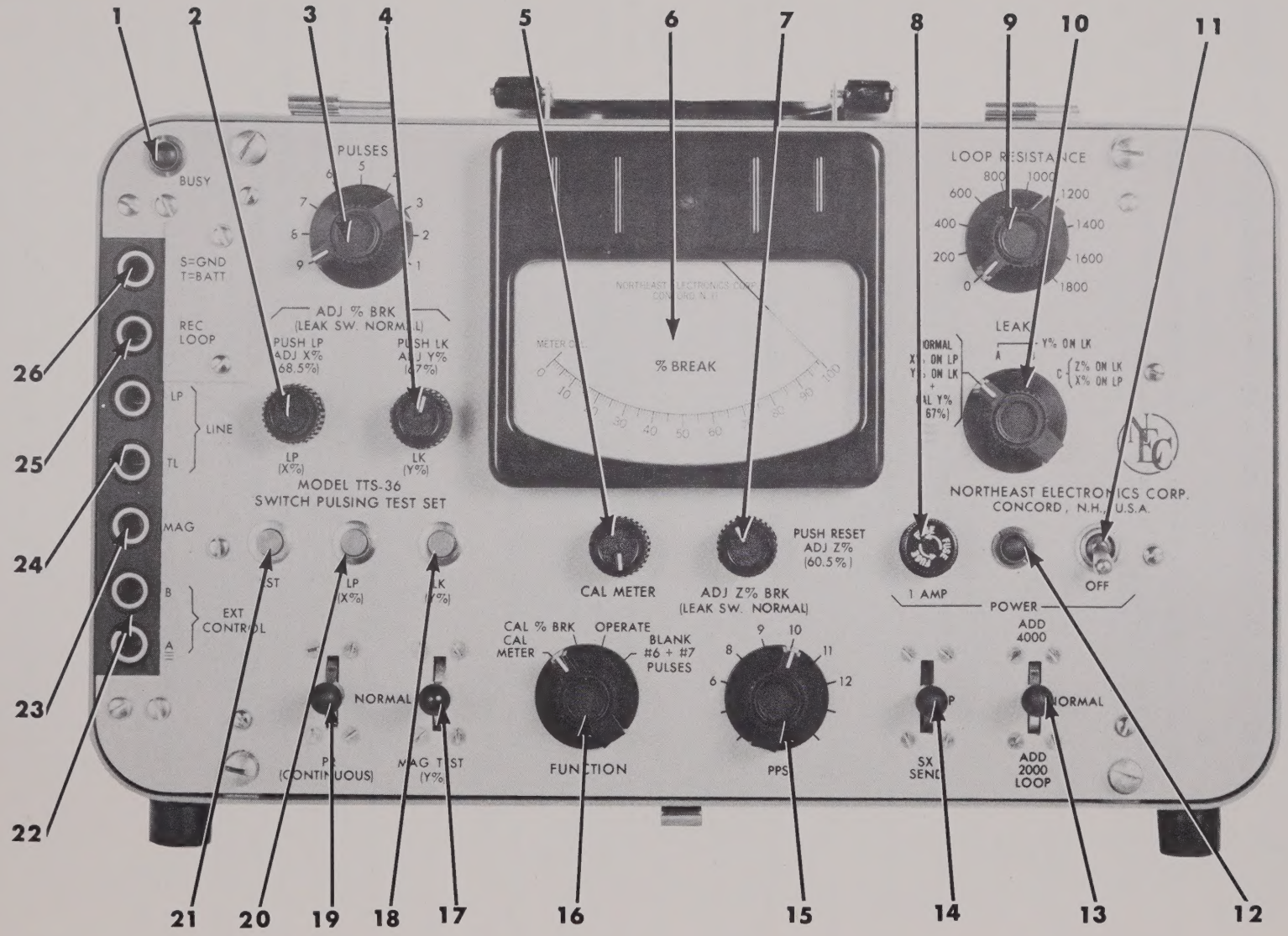


Fig. 2-1 Front Panel Controls

SECTION 2

OPERATING INSTRUCTIONS

2.1 GENERAL. Table 2-1 and figure 2-1 describe and locate all the front panel controls of the TTS 36. Paragraphs 2.2 and 2.3 describe the calibration procedure to be followed before using the test set and paragraphs 2.4 to 2.11 describe the operating procedures.

TABLE 2-1 FRONT PANEL CONTROLS

Name of Control	Figure 2-1 Index No	Type of Control	Ref Desig.	Use or Purpose
BUSY lamp	1	Indicator	DS1	Indicates that the circuit or switch to which the test set has been patched is busy.
LP (X%) control	2	Potentiometer	R15	Used to adjust the % break associated with loop testing.
PULSES switch	3	Rotary switch	S5	Used to control the no. of pulses (1 through 9) in a group, which can be sent at a preset speed and % break.
LK (Y%) control	4	Potentiometer	R16	Used to adjust the % break associated with magnet testing.
CAL METER control	5	Potentiometer	R60	Used to calibrate meter needle to 0% break or METER CAL position.
% BRK meter	6	Meter	M1	Used to indicate % break.
ADJ Z% BRK control	7	Potentiometer	R43	Used to adjust the % break associated with leak testing.

Name of Control	Figure 2-1 Index No.	Type of Control	Ref Desig.	Use or Purpose
1 AMP fuse	8	Fuse		1 amp fuse for protection of set.
LOOP RESIS-TANCE switch	9	Rotary switch	S6	Used to provide balanced loop resistances from 0 to 1800Ω. (The 4000-ADD 2000 provides additional values as required).
LEAK switch	10	Rotary switch	S13	Provides three different values of leak.
ON/OFF switch	11	Toggle switch	S11	Power on/off.
POWER lamp	12	Indicator	DS2	Indicates power on.
ADD 4000 - NORMAL-ADD 2000 switch	13	Key switch	S10	Used in conjunction with LOOP RESISTANCE switch.
LP-SX SEND switch	14	Key switch	S8	LP-Provides loop circuit for step by step switch tests and magnet tests. SX SEND-Provides a simplex pulsing circuit for step by step selectors.
PPS switch	15	Rotary switch	S9	Provides pulse speed in pulses per second.
FUNCTION switch	16	Rotary switch	S7	Provides for selection of different modes of operation.
NORMAL/MAG Test (Y%) switch	17	Key switch	S1	In MAG TEST position allows pulsing of the magnet of a step by step switch
LK (Y%) push-button	18	Pushbutton switch	S3	Initiates LK testing after depression.

Name of Control	Figure 2-1 Index No.	Type of Control	Ref Desig.	Use or Purpose
NORMAL-PR (continuous)	19	Key switch	S12	Used for calibration purposes. Provides continuous instead of groups of pulses.
LP (X%) push-button	20	Pushbutton switch	S2	Initiates LP testing when depressed.
RST pushbutton	21	Pushbutton switch	S4	Used to restore switches or circuits under test to normal.
EXT CONTROL jacks	22	Jacks for 241 type plug	J1 & J2	Used for remote control of the TTS 36.
MAG jack	23	Jack for type 310 plug	J4	Used to pulse directly into magnets of step by step switches.
LINE jacks	24	Jack for type 310 plug	J3 & J5	LP-For pulsing tests on switches and C relays. TL-For testing circuits requiring a busy test.
REC LOOP	25	Jack for type 310 plug	J7	For % brk measurement of an external pulse source.
S-GND T-BATT	26	Jack for type 310 plug	J6	For connecting the set to 48V dc external power.

2.2 CALIBRATION

2.3 Prior to making any tests with the TTS 36, the following calibration procedures should be followed:

a. With the power switch in the off position, check to see that the needle is at the 100% break or the at rest position of the meter. Readjust the needle adjusting screw located at the top center of the meter until needle is in this position. Turn screw slightly in reverse direction to remove any undue pressure against the needle.

b. Connect the set to 48 volts using a 2 conductor cord (tip and sleeve) and with a 310 plug on one end and a suitable connection on the other. Insert the 310 plug into the battery jack on T-BATT S-GND and connect the other end to a suitable 48 volt DC battery supply.

c. Turn the FUNCTION switch to CAL METER.

d. Turn the POWER switch on, the POWER lamp should light. If not, check the power cord connections.

e. Adjust the CAL METER control to obtain 0% break (METER CAL) indication on the meter scale.

f. Turn the FUNCTION switch to CAL % BRK.

g. Turn the LEAK switch to NORMAL. Other keys should be in their normal positions.

h. Set PPS switch to desired pulses per second.

i. Momentarily push the RST button.

j. With the ADJ Z% BRK control, adjust the meter indication to 60.5%.

k. Momentarily depress the LP push button and adjust the LP ADJ X% BRK control to obtain an X% reading of 68.5% on the meter.

l. Depress the RST button.

m. Momentarily depress the LK push button and adjust the ADJ Y% control to obtain a Y% break reading of 67% on the meter.

n. Momentarily depress the RST button.

o. The set is now calibrated and is ready for operational tests as covered in the following paragraphs.

2.4 OPERATING INSTRUCTIONS

2.5 The following procedure is used for pulsing step by step switches through leak and loop circuits simulating the actual line conditions under which these switches operate.

a. Prepare set for operation as outlined in paragraph 2.3

b. Set the PULSES switch at the number corresponding to the switch level desired for the test.

c. The PR, MAG TEST and SX SEND keys should be in the normal position.

d. Turn the PPS switch to the desired number of pulses per second (e.g. 12).

e. Turn the LEAK switch to the desired leak.

f. Turn the LOOP RESISTANCE switch to the required value (e.g. 1200 ohms). If more than 1800 ohms loop resistance is desired, the loop key (in the lower right-hand corner of the panel) may be operated to ADD 2000 or ADD 4000 to increase the value up to a total of 5800 ohms.

g. Turn the FUNCTION switch to OPERATE. Momentarily depress the RST pushbutton.

h. Patch the input of the switch to be tested to the LP jack using a 3 conductor cord with a 310 type or equivalent plug on the end toward the set. If the BUSY lamp lights, it indicates that the switch is busy and a test is not possible.

i. If a remote control accessory is to be used (TTS 26XPC, or Western Electric 36B Test Set), the 241 type plug on this control should be inserted into the A and B jacks with the knurled side to the A jack.

j. On the panel of the set or on the remote control unit, momentary depression of the LP or LK pushbutton will send the preset group of pulses into the switch to operate it to the corresponding level, following which a second depression of the same push button will rotate the switch to the corresponding point on that switch level for connector type switches. After each such operation with either of these pushbuttons, the RST pushbutton should be operated to restore the switch to normal and to clear the circuits set up inside the set prior to depressing either of the LP or LK pushbuttons again. The correct operation of the switch should be observed during these tests.

2.6 To continue the switch test of paragraph 2.5 with a magnet test, proceed as follows.

a. Connect set to switch as covered in paragraph 2.5, step h.

b. With a 2 conductor cord (tip and ring) having a 310 type plug or equivalent on the end toward the set, patch from the MAG TEST jack of the set, to the magnet of the switch under test. Only the tip is used for connections to the magnet. Because of the current carrying limitations, cords with tinsel conductors (as frequently used for 2 conductor cords) are not satisfactory for the connection between the MAG TEST jack and the magnet of the switch under test (#18 gauge wire is recommended).

c. Operate the MAG TEST key.

d. Momentarily depress the RST pushbutton.

e. Turn the PULSES switch to the number representing the desired level to be reached (e.g. position 5 to check operation of the 5th level).

f. Momentarily depress the LK pushbutton and observe whether the operation of the switch magnet has been correct.

g. When it is desired to pulse two groups of digits, as in the case of connectors, the LK pushbutton is held. depressed long enough to start the second group of pulses.

2.7 When it is desired to send continuous pulses instead of groups of pulses, the PR key should be operated and the LK pushbutton should be operated or rather it should be depressed momentarily. The pulsing may be stopped and the circuits returned to normal by momentarily depressing the RST pushbutton (RLS on the remote control unit).

2.8 For some tests on incoming selectors, the required % brk when the pushbutton is depressed may be other than 67% or 60.5%. This will require a recalibration of the set according to the steps given in paragraph 2.3 using these required values in place of those given in paragraph 2.3

2.9 Use of TL jack. For those circuits requiring a "ground forward" the circuit under test should be connected to the TL jack instead of the LP jack. The circuitry associated with the sleeve of the circuit under test upon depressing either the LK or LP pushbutton (this is assuming that the circuit under test is not busy). This ground circuit will remain on the sleeve until such time as the RST or RLS pushbutton is depressed.

2.10 C Relay Test. This test is made like the regular switch test except that the pulses switch is set for 9 pulse groups, and the FUNCTION switch is turned

to the BLANK #6 and #7 PULSES position. Correct operation of the C relay is indicated when the selector cuts in on the 5th level. If it cuts in on a different level, it indicates improper adjustment of the C relay.

2.11 For loop pulsing, the SX SEND key should be at LP (normal position) and the patch is made to the LP jack of the set. For simplex pulsing, the SX SEND key should be operated and the patch is also made to the LP jack. In this latter condition, the tip and ring of the LP jack are strapped together and 220 ohms is inserted between this junction and the contact of the send relay of the set. The circuit is completed from the other contact of the send relay back to the sleeve of the LP jack.

SECTION 3

CIRCUIT DESCRIPTION

3.1 GENERAL. The Model TTS 36 consists of a combination of solid state and electromechanical devices. For the purpose of this description, the TTS 36 circuits will be divided into three parts as follows:

a. Pulse Generating Section. This section includes the oscillator, drive relay, send relay, and their associated components. In general, these circuits are shown on the right-hand side of the schematic diagram, fig. 3-1.

b. Pulse Gating Section. This section includes the RM stepping switch, % break adjusting controls, control relays, and their associated components. These circuits perform the gating, pulse counting and % break switching functions. In general, these circuits are shown in the center of the schematic.

c. Loop, Leak and Busy Sensing Section. This section provides the loop resistance buildout, leak conditions A, B and C, and the busy sensing circuits. In general, these circuits are shown on the left-hand side of the schematic diagram.

3.2 PULSE GENERATING SECTION. Prior to operation, connections and calibrations must be performed as outlined in Section 2. This having been accomplished, the drive relay is generating a continuous train of pulses at a % break and speed as determined by the oscillator and the ADJ Z% BRK control. Pulsing will not appear on either the MAG or LOOP output jacks until such time as either the LP or LK button is depressed.

3.3 In the idle condition, the pulses generated by the drive relay are applied to the armature of relay STF; however, as STF is in a released condition, these pulses cannot be applied to any of the gating circuits. In the idle condition, relay CMP is normally operated, thus extending ground via the clamp lead to the send relay. This ground circuit maintains the send relay in a steady off-hook (closed) condition. For normal loop pulsing, the contacts of the send relay are switched to the LP and TL jacks via the loop and leak circuits. Thus, sub-pulses generated by

the send relay will be applied to the circuit under test through the leak and loop circuits.

3.4 When key switch S1 is in the MAG TEST position, a make contact of the send relay is switched to the ring of the MAG TEST jack and the armature of the send relay is connected to ground via a make contact of relay CMPF. Thus, ground and open pulsing are generated for magnet testing.

3.5 For calibration purposes, the FUNCTION switch is moved to the CAL % BRK position. In this position, ground applied to the send relay via the clamp lead is interrupted and the send relay contacts are switched to the meter circuit. In this condition, the send relay is now under direct control of the drive relay and the output pulsing is now routed to the % break meter circuit to allow direct observation of the % break.

3.6 The PR position of S12 also interrupts the ground applied to the send relay via the clamp lead. The purposes of this position is to allow a continuous pulse train to be applied to the circuit under test. In the NORMAL position of S2, pulses are applied to the circuit under test under control of the gating circuits. The number of pulses within a given pulse train is determined by the positioning of S5. The pulses within a given train can range from 1 through 9, depending on the settling of switch S5.

3.7 PULSE GATING SECTION. The gating circuits of the TTS 36 are placed in operation by depressing either the LP or LK button on the remote control head. Either of these buttons, when depressed, will extend a ground circuit, originating at the contacts of the busy test relay BS within the loop and leak section, to the ST relay. Should the circuit under test be busy, the BS relay would be in operated condition and no ground circuit would be established, thereby making it impossible to initiate any further testing. Assuming the circuit under test is free, the ground circuit established will operate start relay ST. Relay ST, operated, extends the battery through current limiting resistance to the start follow relay STF. The function of STF is to insure that the gating circuits will start in proper phase with the drive relay to insure that the first pulses applied to the circuit under test will be of the same duration in time as those following. Relay STF, when operated, extends the pulsing circuit of the drive relay to stepping switch RM; ground pulses generated by the drive relay will cause RM to step.

3.8 Prior to RM moving from its home position (RM is shown in the home position on the schematic), clamp relay CMP is maintained energized. In the case of normal loop pulsing CMP is not released until

after RM has taken its third step. Simultaneously with the first operation of RM, off-hook relay OH is operated. The operation of relay OH completes the loop circuit, thus extending an off-hook condition to the circuit under test. The duration of this off-hook condition will be equal to three operations of the RM stepping switch. This off-hook period is necessary to satisfy the requirements of the switch circuits under test. Stepping switch RM, when leaving its third position, removes ground from the coil of CMP, thus allowing it to release. CMP released removes ground from the clamp lead, hence from the send relay. The send relay will follow pulses generated by the drive relay, in turn generating DC interruptions on the loop circuit. These DC interruptions will continue until such time as stepping switch RM steps from position 11 to position 12 (home). Upon returning to its home position, ground appearing on the wiper of RM is again extended to the CMP relay, which in turn applies ground to the clamp, thus stopping the send relay in an off-hook condition.

3.9 In the above operation, a total of 9 pulses have been transmitted to the circuit under test, assuming of course that rotary switch S5 is in position 9. Stepping switch RM, when returning to its home position, also applies ground through diode CR8 to the junction of R3 and R4, and the sustaining voltage for start follow relay STF is removed, allowing it to release. As STF is now released, further pulsing of RM is not possible until such time as a new start command is received. It should be noted that off-hook relay OH remains energized over its own locking contacts to the ground circuit established by the BS relay; thus the circuit under test is held in an off-hook condition. The circuit is returned to on-hook by depressing the RLS button momentarily. The RLS button, when depressed, applies ground to the OH relay side of R17, thus allowing it to release, in turn interrupting the loop circuit to return it to on-hook.

3.10 In conjunction with the above operation, other relays, such as LK1, LK2, LK3, and LP, perform such functions as establishing the proper % break and the switching in and out of the various leak and loop conditions as required. The operation of these relays will be explained in more detail later. The function of the diodes used in the various circuits is to provide circuit isolation as required.

3.11 Pushbutton switches S2, S3 and S4, which are located on the main panel, are provided to allow normal operation of the unit in the absence of the remote control head.

3.12 LOOP, LEAK AND BUSY SENSING SECTION. Magnet testing is performed by moving key switch S1 to the MAG TEST position. The loop cir-

cuit of the switch under test connects to the LP jack (or to the TL jack when a ground forward is required). This places the loop circuit of the switch under test in an off-hook condition (assuming that circuit to be free prior to depressing the LK button). If that circuit is not free, the BS relay will operate, rendering any further testing impossible.

3.13. Clamp follow relay CMPF is now brought into operation. The function of CMPF is to extend ground to the send relay during the period when the send relay contacts are open and prior to the transmission of the first ground pulse to the magnet under test. It should be noted that under normal loop operation, a closed loop or off-hook condition is established by relay OH when the send relay contacts are closed.

3.14 Several other circuits are also switched when moving S1 to the MAG TEST position. These circuits are associated with the operation of relay CMP and relay CMPF. This switching is necessary to provide the proper timing between the operation of relay CMP and the drive pulses as delivered by the drive relay. This timing between the operation of relay CMP and the drive pulses as delivered by the drive relay. This timing must be different from that of normal loop operation, as the send relay must be placed in operation approx. 180^{o} earlier in time than for normal loop operation. If this timing were not shifted, and the CMPF and OH relays were to operate during the off-hook duration of the send pulse, a portion of the ground pulse would be applied to the magnet under test will be of proper duration.

3.15 It is necessary that the ground circuit to the send relay be removed upon the completion of the last ground pulse transmitted to the magnet under test. This is accomplished by releasing relay CMPF at the proper time. Depending on the position of switch S5, ground will be extended via the arm of stepping switch RM and the RM contact of RM to relay CMPF, thus causing it to release at the proper time. Capacitor C2, which is switched into the coil circuit of relay CMP under mag test operation, provides a delay in the release of relay CMP to insure that the release of CMP will be in the proper phase relationship with respect to the operation of the drive relay. Capacitor C3 in the coil circuit of relay CMPF prevents CMPF from operating momentarily, while stepping switch RM is to its home position prior to the operation of CMP.

3.16 A certain % break of the pulses transmitted under normal loop or mag loop operation must be established. The % break associated with the various leak, loop or mag test conditions are shown in the table on the schematic diagram, fig. 3-1. For other types of tests, i.e. incoming selector tests, the % break as called out in the above table will not apply.

3.17 With the FUNCTION switch in the CAL % BRK position, the ADJ

% BRK control is adjusted to provide the % break to be associated with normal or leak testing. This adjustment must be first in sequence, as this resistance remains a part of the bias control when the LP or MAG TEST mode of operation.

3.18 MAG TEST. In the MAG TEST mode of operation, ground and open pulses at 67% break are applied to the magnet test. Depressing the LK button will cause relay LK2 to energize. Relay LK2, when energized, will complete the circuit for bias adjust resistor R16. This control should now be adjusted to obtain a reading of 67% break. It should be noted that the LEAK switch on the TTS 36 is shown in the NORMAL position for this adjustment. This switch, when in the LEAK A, B or C position, applies ground to the coil circuit of relay LK2 to prevent its operation. Otherwise LK2 would release upon release of the LK button. Relay LK3 does not perform any significatn function in the MAG TEST mode of operation.

3.19 When depressing the LP pushbutton, relay LP will operate. The operation of relay LP switches bias adjust resistor R15 into the bias circuit. This control should be adjusted to provide a reading of 68.5% break. For leaks, A, B and C relay, LK2 is held in a de-energized condition by the ground circuit established by deck A3 of the LEAK switch. (Should LK2 be allowed to operate, a % break of 67% would be established rather than the required 60.5%). In the LEAK C position of the circuit switch, relay LK3 is maintained in a de-energized condition in the same manner as relay LK2. Preventing operation of relay LK3 allows the loop resistance of the TTS 36 to remain in the circuit when depressing the LK button, thus applying both leak and loop to the circuit under test. This condition is only established when depressing the leak button with the circuit switch in the LEAK C position. It should be noted that in this position, relay LP does not operate, thus the leak circuits remain established.

3.20 Blank #6 and #7 Pulses. In order to provide an interdigital timing test of the C relay, the #6 and #7 pulses within a train of 9 pulses must be omitted. This is accomplished by placing the FUNCTION switch to the #6 and #7 pulses position. In this position, contacts on stepping switch RM which are related to the #6 and #7 pulses, are extended to relay CMP. Thus relay CMP will operate to clamp the send relay to blank out pulses #6 and #7.

3.21 SX SEND. Key switch S8, when operated to the SX SEND position, connects the tip and ring of the LP jack together and inserts 220 ohms between this junction and the contacts of the send relay of the set. The circuit is completed from the other contact of the send relay back to the sleeve of the LP jack.

3.22 The REC LOOP jack allows input of an external source of pulses to allow % break measurements. The external signal is fed directly to the meter circuits when FUNCTION switch S7 is in either OPERATE or BLANK #6 and #7 PULSES position.

3.23 OSCILLATOR-BUFFER AMPLIFIER CIRCUIT

3.24 The oscillator-buffer amplifier circuitry contained within the Model TTS 36 is normally equipped to operate on any of the following frequencies: 6, 8, 9, 10, 11 and 12 cps. Additional frequencies can be installed on special order. The purpose of the oscillator-buffer circuitry is to provide an output sinewave to operate the drive relay. This circuit is contained on a printed board which is a sub-unit.

3.25 The output sinewave of this unit is coupled to the drive relay. Through the adjustment of the ADJ % BRK controls associated with the drive relay, the point on the sinewave at which the drive relay will operate can be varied, thus the adjustable % break is achieved.

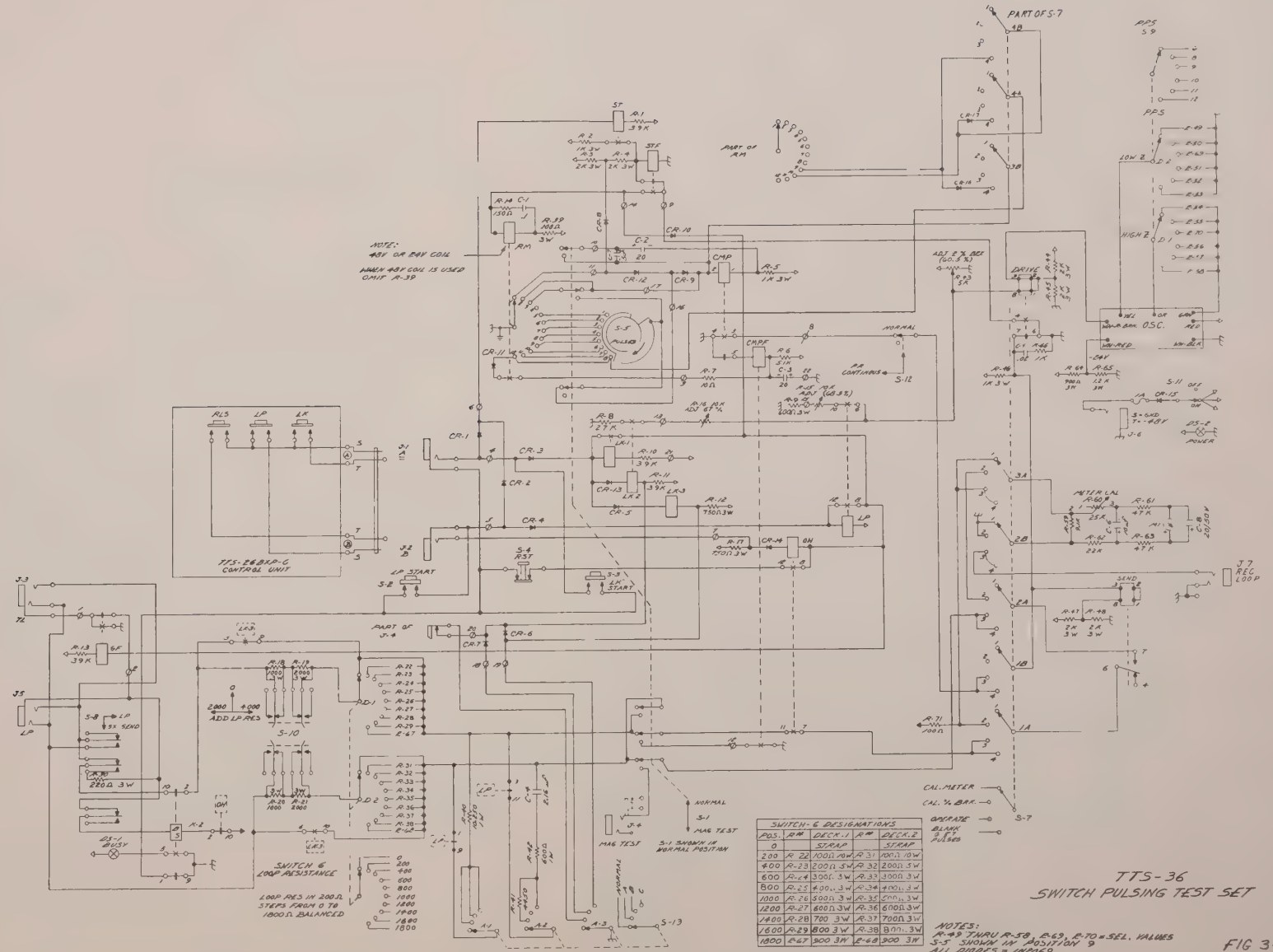
3.26 As transistorized circuits are used, no external power other than the 48 volt station battery is required; no warm-up period is required for this unit. The operation of the circuit is as follows:

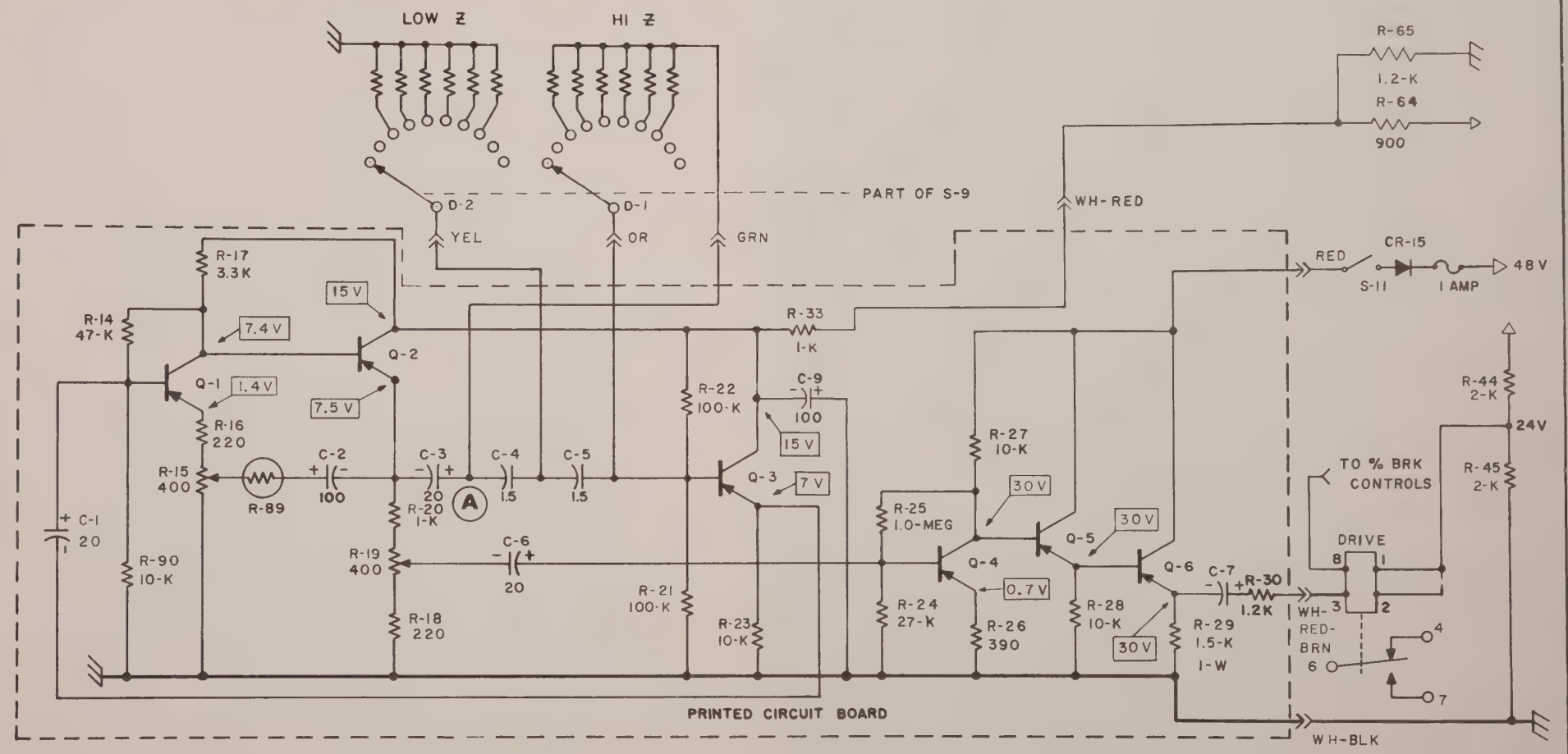
3.27 The circuit diagram to which the following description applies is shown in fig. 3-2.

3.28 A bridged-T type of R-C oscillator consisting of three transistor stages, is used. The first two transistors are directly coupled from the collector of Q1 to the base of Q2. The positive feedback path is completed from the emitter of Q2 back through a blocking capacitir C2 and a tungsten lamp, R89, utilized for level stabilization, to the emitter of Q1. A part of the emitter resistance, R15, of Q1 has been made variable to allow setting the correct amount of positive feedback necessary for stable operation.

3.29 A negative feedback which is greater than the positive feedback is supplied to the base of Q1 through a null selective network and an emitter follower, Q3. At its tuned frequency, the selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the desired frequency, which is determined by the R-C values employed within the network. This frequency determining network consists of two capacitors, C4 and C5, and two selected value resistors.

3.30 Amplifier stage Q4 and the cascade emitter follower stages, Q5 and Q6 provide the necessary voltage and current gain required to operate the drive relay. The output level of the amplifier stage is determined by the setting of potentiometer R19. Capacitor C7 provides DC blocking between the output emitter follower Q6 and the driven coil of the drive relay.


PART OF S-7
PPS S-9
ST
R-1 39K
STF
R-2
R-3 2K 3W
R-4 2K 3W
PART OF RM
RM
R-14 C-1 150Ω
R-39 100Ω 3W
CR-8
CR-10
C-2
CMP
R-5 1K 3W
CR-12
CR-9
CR-11
S-5 PULSER
CMPF
R-6 5.1K
C-3
R-7 10Ω
R-8 27K
R-16 10K ADJ 6T
R-9 200Ω 3W
R-15 ADJ (50 Ω)
NORMAL
S-12
ADJ 2 % REC (50.3 K)
DRIVE
R-46 1K 3W
R-69 R-65 3W
C-4 .05
C-1 .68
OSC.
-24V
J-6
S-11
CR-15
J-5 POWER
RLS LP LK
TTS-26BXP-G CONTROL UNIT
CR-1
CR-2
CR-3
CR-4
LK-1
LK-2
LK-3
R-10 39K
R-11 39K
R-12 750Ω 3W
CR-5
CR-13
R-17 750Ω 3W
CR-14
LP
S-4 RST
S-3 LP START
S-2 LP START
PART OF J-4
CR-6
CR-7
R-13 39K
R-18 1000
R-19 2000
R-22
R-23
R-24
R-25
R-26
R-27
R-28
R-29
E-67
S-10
2000 4000 ADD LP RES
S-8 LP 95 SEND
R-30 220Ω 3W
R-20 1000
R-21 2000
R-31
R-32
R-33
R-34
R-35
R-36
R-37
R-38
E-68
SWITCH 6 LOOP RESISTANCE
LOOP RES IN 200Ω STEPS FROM 0 TO 1800Ω BALANCED
0 200 400 600 800 1000 1200 1400 1600 1800
R-40 1000Ω 10W
R-41 4000Ω 10W
MAG TEST
S-1 SHOWN IN NORMAL POSITION
S-13
MOMENTARY
R-60 25K
R-61 47K
R-62 22K
R-63 47K
.1 .05 400V
J-7 REC LOOP
SEND
R-47 5K 3W
R-48 2K 3W
R-71 100Ω
CAL. METER
CAL. ½ BAR.
OPERATE
BLANK 2 PULSES
S-7
SWITCH-6 DESIGNATIONS
POS. | RM DECK-1 STRAP | RM DECK-2 STRAP
0 | | |
200 | R-22 100Ω 10W | R-31 100Ω 10W
400 | R-23 200Ω 5W | R-32 200Ω 5W
600 | R-24 300Ω 3W | R-33 300Ω 3W
800 | R-25 400Ω 3W | R-34 400Ω 3W
1000 | R-26 500Ω 3W | R-35 500Ω 3W
1200 | R-27 600Ω 3W | R-36 600Ω 3W
1400 | R-28 700 3W | R-37 700Ω 3W
1600 | R-29 800 3W | R-38 800Ω 3W
1800 | E-67 900 3W | E-68 900 3W
NOTES:
R-49 THRU R-58, R-63, R-70 = SEL. VALUES
S-5 SHOWN IN POSITION 9
ALL DIODES = IN2069
TTS-36
SWITCH PULSING TEST SET
FIG 3-1



NOTES: 1. TRANSISTORS Q1 THRU Q5: 2N1375, Q6: 2N1136A.
2. DC MEASUREMENTS TAKEN WITH TRIPLETT 630NA VOM OR EQUIVALENT.

FIG 3-2 OSCILLATOR-BUFFER AMPLIFIER

SECTION 4

MAINTENANCE INSTRUCTIONS

4.1 OSCILLATOR-BUFFER AMPLIFIER MAINTENANCE AND FAULT FINDING.

4.2 Should abnormal operation of the oscillator sub-unit occur, proceed as follows:

a. Referring to Fig. 3-2, connect an oscilloscope between point A and ground. The sinewave voltage appearing between these two points should be approximately 2.5 volts peak to peak. If not, adjust potentiometer R15 to achieve this level. Turning R15 in a clockwise direction increases the output level appearing at this point once the level has been adjusted to approx. 2.5 volts peak to peak. A slight amount of clipping on the peaks of this waveform need not cause alarm, as this is a normal adjustment.

b. If there is no voltage between point A and ground (with R15 in maximum clockwise position), check the filament of the tungsten lamp, R89, for continuity. Replace lamp if faulty. If the lamp is good, substitute transistors, starting with Q1 and ending with Q3. If trouble still prevails, check for proper DC voltages as indicated on the schematic diagram of the circuit. These voltages should be within ±10% as indicated. An open condition of filter capacitor C9 can also cause faulty operation and can be checked through substitution.

4.3 Should the preceding steps fail to produce an output of the oscillator at point A, check other component parts contained within the oscillator circuit such as resistors, capacitors and the pulse frequency switching network. It is important after the correction of the trouble to readjust potentiometer R15 to produce a 2.5 peak to peak voltage indication at point A of the oscillator board.

4.4 With the oscillator operating properly, check the peak to peak voltage appearing at pin 3 of the drive relay. This voltage should be in the order of 7 volts peak to peak. The exact voltage depends on the setting of the gain control R19. The normal setting for this control is approx. in its mid position. If normal signal voltage is not realized at this point, check the buffer-amplifier portion of the circuit.

This circuit consists of transistors Q5, Q4 and Q6 and their associated circuitry.

4.5 If a normal voltage appears at pin 2 of the drive relay, and trouble still prevails, the trouble will be found in either the drive relay, the send relay or their bias networks. When the SEND BIAS control is in its mid position, the DC voltage between pins 1 and 8 of the drive relays should be very close to 0.

4.6 Should trouble be traced to either the drive or send relay, it is recommended that these relays be removed and tested with proper test equipment such as the Sigma 4500 Series Test Set or equivalent.

SECTION 5

ELECTRONICS PARTS LIST

5.1 The following pages contain the parts list for the Model TTS 36 Switch Pulsing Test Set.

5.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of codes and their respective manufacturers is given on page

5.3 Abbreviations used in the Parts List.

C - capacitor
R - resistor
CB - circuit board
fxd - fixed
elect - electrolytic
var - variable
ww - wirewound
mtl film - metal film
comp - composition
sel val - selected value

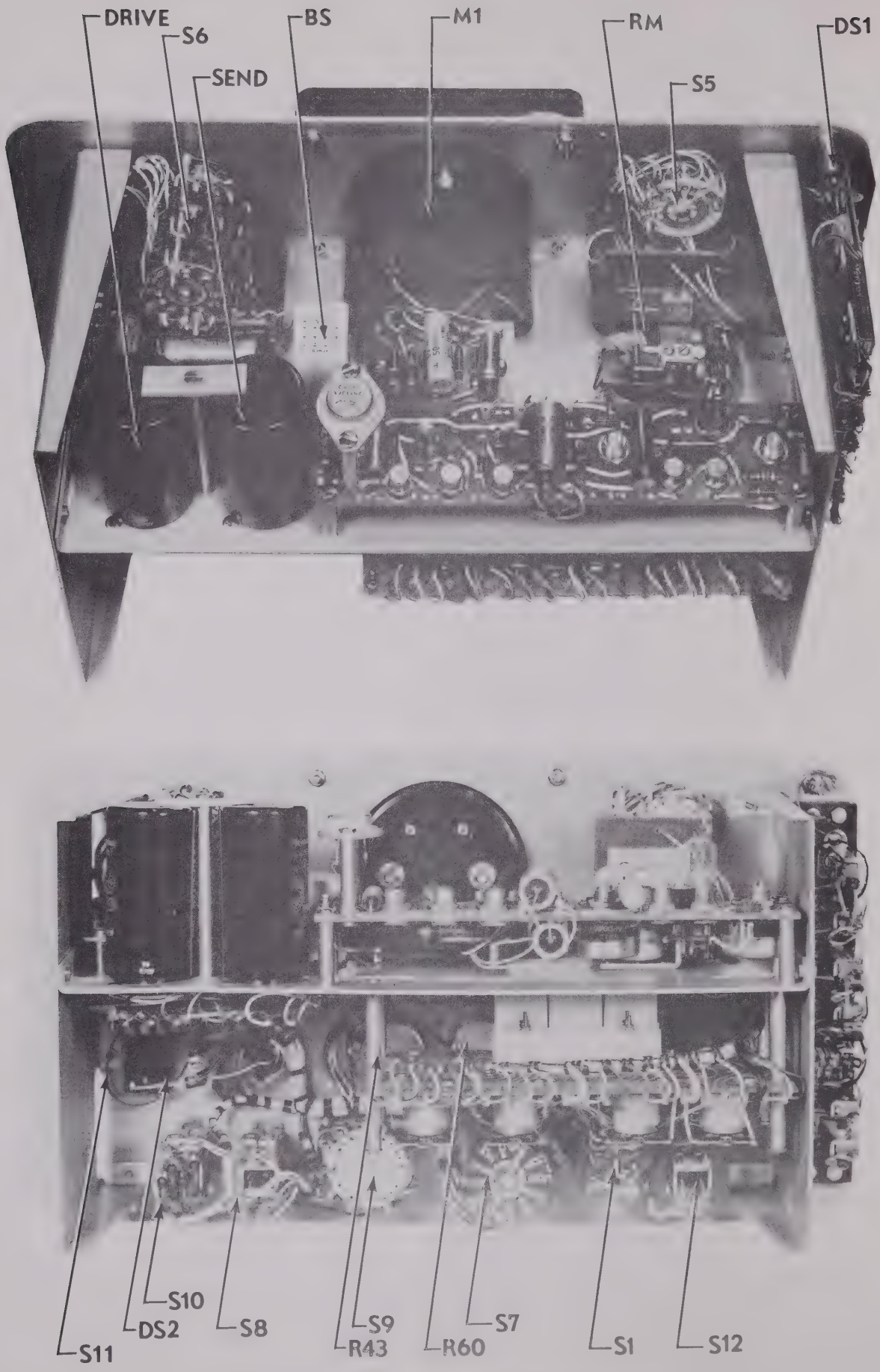


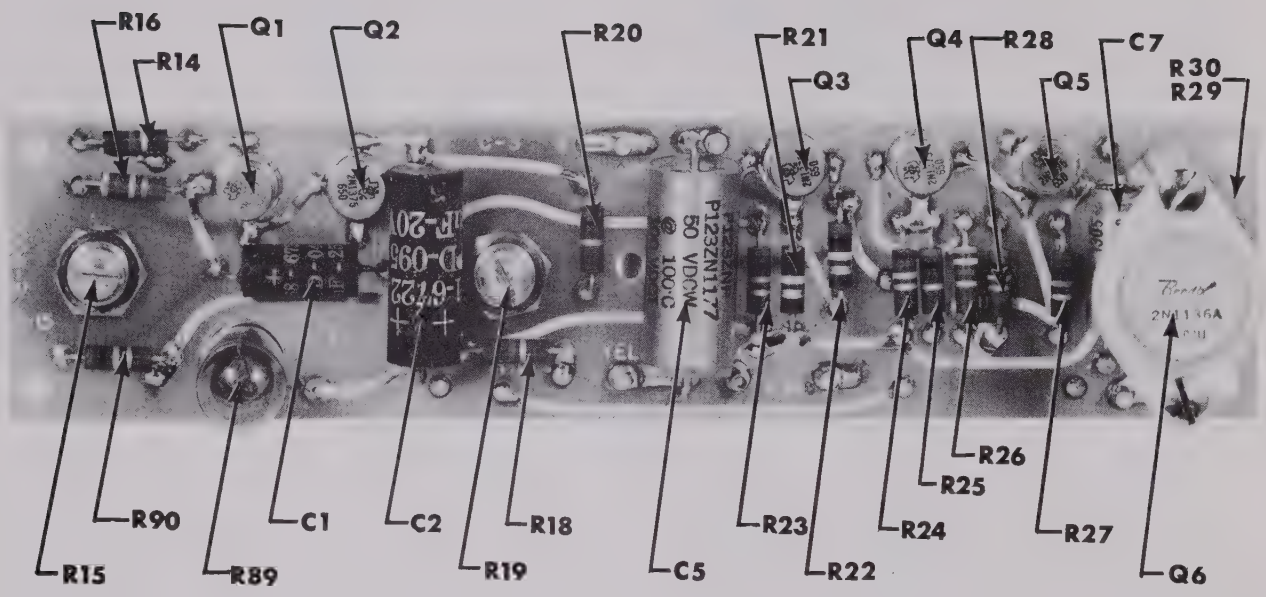
Figure 5-1 TPS 35 Top and Rear Views

MAIN ASSEMBLY

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C 6	C: fxd elect 10μF 50 Vdc	13606	TVA1304
C 8	C: fxd elect 20μF 50 Vdc	13606	TE1305
CB1	Circuit Board	06819	CB1-TTS 36
R15	R: var ww 10k	12697	CM33382 NP
R16	R: var ww 10k	12697	CM33382 NP
R18	R: fxd ww 1.0 kohms ±1% 3W	91637	RS2B
R19	R: fxd ww 2.0 kohms ±1% 3W	91637	RS2B
R20	R: fxd ww 1.0 kohms ±1% 3W	91637	RS2B
R21	R: fxd ww 2.0 kohms ±1% 3W	91637	RS2B
R22	R: ww 100 ohms ±1% 10W	91637	RS10
R23	R: fxd ww 200 ohms ±1% 5W	91637	RS5
R24	R: fxd ww 300 ohms ±1% 3W	91637	RS2B
R25	R: fxd ww 400 ohms ±1% 3W	91637	RS2B
R26	R: fxd ww 500 ohms ±1% 3W	91637	RS2B
R27	R: fxd ww 600 ohms ±1% 3W	91637	RS2B
R28	R: fxd ww 700 ohms ±1% 3W	91637	RS2B
R29	R: fxd ww 800 ohms ±1% 3W	91637	RS2B
R30	R: fxd ww 220 ohms ±5% 3W	13606	242E2215
R31	R: fxd ww 100 ohms ±1% 10W	91637	RS10
R32	R: fxd ww 200 ohms ±1% 5W	91637	RS5
R33	R: fxd ww 300 ohms ±1% 3W	91637	RS2B
R34	R: fxd ww 400 ohms ±1% 3W	91637	RS2B
R35	R: fxd ww 500 ohms ±1% 3W	91637	RS2B
R36	R: fxd ww 600 ohms ±1% 3W	91637	RS2B
R37	R: fxd ww 700 ohms ±1% 3W	91637	RS2B
R38	R: fxd ww 800 ohms ±1% 3W	91637	RS2B
R40	R: fxd ww 10.250 kohms ±1% 3W	91637	RS2B
R41	R: fxd mtl flm 4450 ohms ±1% ½W	11502	CEATO
R42	R: fxd ww 600 ohms ±1% 3W	91637	RS2B
R43	R: var ww 5k	12697	CM30154 NP
R44	R: fxd ww 2.0 kohms ±5% 3W	13606	242E2025
R45	R: fxd ww 2.0 kohms ±5% 3W	13606	242E2025
R46	R: fxd ww 1.0 kohms ±5% 3W	13606	242E1025
R47	R: fxd ww 2.0 kohms ±5% 3W	13606	242E2025
R48	R: fxd ww 2.0 kohms ±5% 3W	13606	242E2025
R49	R: fxd comp sel val ±10% ½W	01121	
R50	R: fxd comp sel val ±10% ½W	01121	
R51	R: fxd comp sel val ±10% ½W	01121	

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
R52	R: fxd comp sel val ±10% ½W	01121	
R53	R: fxd comp sel val ±10% ½W	01121	
R54	R: fxd comp sel val ±10% ½W	01121	
R55	R: fxd comp sel val ±10% ½W	01121	
R56	R: fxd comp sel val ±10% ½W	01121	
R57	R: fxd comp sel val ±10% ½W	01121	
R58	R: fxd comp sel val ±10% ½W	01121	
R59	R: fxd comp 9.1 kohms ±10% ½W	01121	
R60	R: var ww 25k	71590	WN-253
R61	R: fxd comp 4.7 kohms	01121	
R62	R: fxd comp 3.22 kohms	01121	
R63	R: fxd comp 4.7 kohms	01121	
R64	R: fxd ww 900 ohms ±5% 3W	13606	242E9015
R65	R: fxd ww 1.2 kohms ±10% ½W	13606	242E1225
R66	R: fxd comp 1.0 kohms ±10% ½W	01121	
R67	R: fxd ww 900 ohms ±1% 3W	91637	RS2B
R68	R: fxd ww 900 ohms ±1% 3W	91637	RS2B
R69	R: fxd comp sel val ±10% ½W	01121	
R70	R: fxd comp sel val ±10% ½W	01121	
R71	R: fxd comp 100 ohms ±10% ½W	01121	
CR15	Diode: silicon	80368	1N2069
CR17	Diode: silicon	80368	1N2069
RM	Relay: stepping	77342	GM-1124
M1	Meter: special CTB-26A	06819	Spec 124
Send	Relay: SPDT Polar	78277	72AOZ-1000
Drive	Relay: SPDT Polar	78277	72AOZ-1000
BS	Relay: 48V dc	04221	156-4023
J1	Jack: telephone	78957	5 J-1194
J2	Jack: telephone	78957	5J-1104
J3	Jack: telephone	78957	5J-1329
J4	Jack: telephone	78957	5J-1191
J5	Jack: telephone	78957	5J-1329
J6	Jack: telephone	78957	5J-1194
J7	Jack: telephone	78957	5J-1194
S1	S: telephone key	78957	170K
S2	S: push mom contact (LPX%)*	82389	903
S3	S: push mom contact (LKY%)*	82389	903
S4	S: push mom contact (RST)*	82389	903
S5	S: rotary	71590	PA2042
S6	S: rotary	71590	PA1015
S7	S: rotary	71590	PA1027
S9	S: rotary	71590	PA1027
S8	S: telephone key	82389	170E

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
S10	S: telephone key	71590	173N
S11	S: toggle, SPST	04009	20994
S12	S: telephone key	82389	170E
S13	S: rotary *	82389	170E
XF1	Fuse holder		
F1	Fuse 1A	75915	3AG1
	Pulse Generator PC bd Complete	06819	E95026
	PC Bd Complete	06819	E95051
XDS1	Lamp holder	72619	105
DS1	Lamp	71744	60A
XDS2	Lamp holder	72619	105
DS2	Lamp	71744	60A



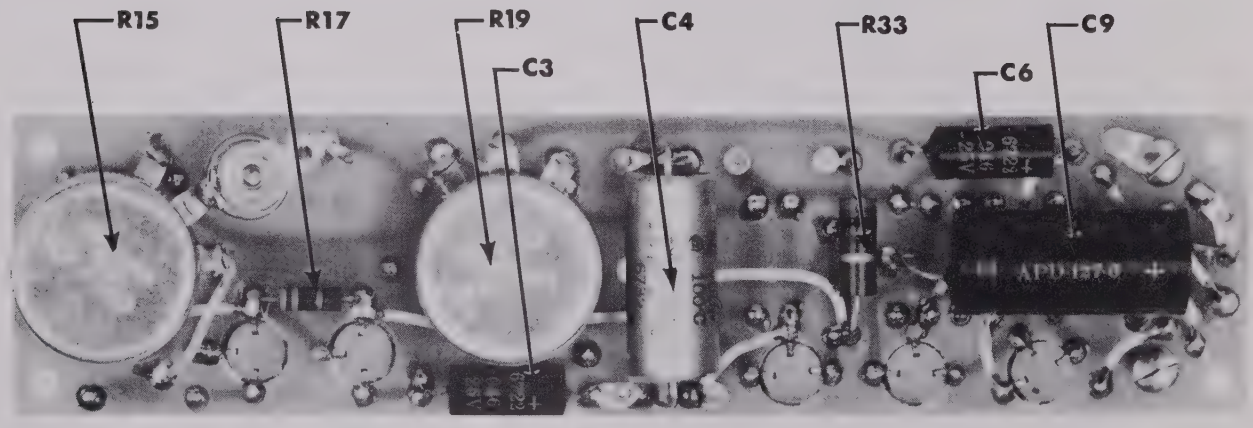


Fig. 5-2 PC Board E95026

PULSE GENERATOR

(PC Bd E95026)

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C 1	C: fxd elect 20μF 25 Vdc	24138	APD-046
C 2	C: fxd elect 100μF 20 Vdc	24138	APD-095
C 3	C: fxd elect 20μF 25 Vdc	24138	APD-046
C 4	C: fxd paper 1.5μF 150 Vdc	13606	P1232N
C 5	C: fxd paper 1.5μF 150 Vdc	13606	P1232N
C 6	C: fxd elect 20μF 25 Vdc	24138	APD-046
C 7	C: fxd elect 20μF 50 Vdc	13606	TE1305
C 9	C: fxd elect 100μF 50 Vdc	24138	APD-127
R15	R: var ww 400 ohms	71590	CM22425
R14	R: fxd comp 47 kohms ±10% ½W	01121	
R16	R: fxd comp 220 ohms ±10% ½W	01121	
R17	R: fxd comp 3.3 kohms ±10% ½W	01121	
R18	R: fxd comp 220 ohms ±10% ½W	01121	
R19	R: var ww 400 ohms	71590	
R20	R: fxd comp 1.0 kohms ±10% ½W	01121	
R21	R: fxd comp 100 kohms ±10% ½W	01121	
R22	R: fxd comp 100 kohms ±10% ½W	01121	
R23	R: fxd comp 10 kohms ±10% ½W	01121	
R24	R: fxd comp 27 kohms ±10% ½W	01121	
R25	R: fxd comp 1 megohm ±10% ½W	01121	
R26	R: fxd comp 390 ohms ±10% ½W	01121	
R27	R: fxd comp 10 kohms ±10% ½W	01121	
R28	R: fxd comp 10 kohms ±10% ½W	01121	
R29	R: fxd comp 1.5 kohms ±10% 1W	01121	
R30	R: fxd comp 1.2 kohms ±10% ½W	01121	
R33	R: fxd comp 1.0 kohms ±10% 1W	01121	
R89	Lamp: tungsten (used as resistor) 4W 120 V	73869	T4 ½
R90	R: fxd comp 10 kohms ±10% ½W	01121	
Q1	Transistor: PNP	01295	2N1375
Q2	Transistor: PNP	01295	2N1375
Q3	Transistor: PNP	01295	2N1375
Q4	Transistor: PNP	01295	2N1375
Q5	Transistor: PNP	01295	2N1375
Q6	Transistor: PNP Power	12143	2N1136A

Fig. 5-3 PC Board E95051

5-8

PC Bd. E95051

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C 1	C: fxd paper .1μF 75 Vdc	71590	DDA-104
C 2	C: fxd elect 20μF 50 Vdc	13606	TE1305
C 3	C: fxd elect 20μF 50 Vdc	13606	TE1305
R 1	R: fxd comp 3.9 kohms ±10% ½W	01121	
R 2	R: fxd ww 1.0 kohms ±5% 3W	13606	242E1025
R 3	R: fxd ww 2.0 kohms ±5% 3W	13606	242E2025
R 4	R: fxd ww 2.0 kohms ±5% 3W	13606	242E2025
R 5	R: fxd ww 1.0 kohms ±10% 3W	13606	242E1025
R 6	R: fxd comp 5.6 kohms ±10% ½W	01121	
R 7	R: fxd comp 10 ohms ±10% ½W	01121	
R 8	R: fxd comp 2.7 kohms ±10% ½W	01121	
R 9	R: fxd ww 600 ohms ±5% 3W	13606	4414
R10	R: fxd comp 3.9 kohms ±10% ½W	01121	
R11	R: fxd comp 3.9 kohms ±10% ½W	01121	
R12	R: fxd ww 750 ohms ±5% 3W	13606	4418
R13	R: fxd comp 3.9 kohms ±10% ½W	01121	
R14	R: fxd comp 150 ohms ±10% ½W	01121	
R17	R: fxd ww 750 ohms ±5% 3W	13606	4418
CR 1	Diode: silicon	80368	1N2069
CR 2	Diode: silicon	80368	1N2069
CR 3	Diode: silicon	80368	1N2069
CR 4	Diode: silicon	80368	1N2069
CR 5	Diode: silicon	80368	1N2069
CR 6	Diode: silicon	80368	1N2069
CR 7	Diode: silicon	80368	1N2069
CR 8	Diode: silicon	80368	1N2069
CR 9	Diode: silicon	80368	1N2069
CR10	Diode: silicon	80368	1N2069
CR12	Diode: silicon	80368	1N2069
CR13	Diode: silicon	80368	1N2069
CR14	Diode: silicon	80368	1N2069
LK1	Relay: 2500 ohm coil '1C'	77342	RS5D
LK2	Relay: 2500 ohm coil '1C'	77342	RS5D
LK3	Relay: 26.5 VDC coil '4C'	04221	156-4022
GF	Relay: 2500 ohm coil '1C'	77342	RS5D
STF	Relay: 2500 ohm coil '1C'	77342	RS5D
ST	Relay: 2500 ohm coil '1C'	77342	RS5D
CMPF	Relay: 2500 ohm coil '1C'	77342	RS5D
LP	Relay: 48 VDC coil '4C'	04221	156-4023
OH	Relay: 26.5 VDC '4C'	04221	156-4023
CMP	Relay: 1000 ohm coil '1C'	94696	W103MPCX4
C7	C: elect 5μF 50 Vdc	13606	TVA1303

LIST OF MANUFACTURERS CODE NUMBERS

Number	Manufacturer
01121	Allen Bradley Company
01295	Texas Instruments Incorporated
04009	Arrow-Hart & Hegeman
04221	Aemco
06819	Northeast Electronics Corporation
11502	International Resistance Corporation
12143	Bendix Corporation
12697	Clarostat Manufacturing Company
13606	Sprague Electric Company
24138	International Electronics Corporation
71590	Centralab
72663	General Control Company
73869	Herzog Miniature Lamp Works, Incorporated
75915	Littlefuse, Incorporated
77342	Potter & Brumfield Sales Company
78277	Sigma Instruments Incorporated
78957	Stromberg-Carlson Corporation
80368	Sylvania Electric Products, Company
82389	Switchcraft, Incorporated
91637	Dale Electronics Corporation
94696	Magnecraft Electric Company

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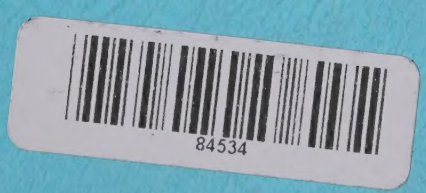
CHANGE NOTICE SUMMARY

Revision	Reason for Change	Date of Change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